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INVESTIGATION OF ATMOSPHERIC PROPERTIES BASED UPON  
EVALUATION OF INFRARED RADIATION DATA OBTAINED FROM  
TIROS SATELLITES

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## 1. INVESTIGATIONS BEING UNDERTAKEN

- a. A method developed for the determination of the mean relative humidity of the upper troposphere and of the temperature of emitting surfaces (ground or cloud tops) from infrared radiation data of TIROS III will be applied on radiation data of the TIROS IV satellite. The main preliminary work, construction of evaluation diagrams and studies of the upward infrared radiation flux within the filter regions of the TIROS IV radiometers, has been completed in the period covered by this report.
- b. There has been developed a method for the calculation of the outgoing radiation of several overlapping bands of different atmospheric gases. For this case the numerical integration of the equation of radiative transfer has been programmed in Fortran for an IBM 7090 computer during the past grant. The results of these calculations in different spectral ranges have been given in our Final Report of May 1965. The reported method especially may be applied to measurements with a spectral resolution between 100 and  $700\text{ cm}^{-1}$  (in the infrared part of the electromagnetic spectrum).

Now absorption functions have been prepared for using our method in the region of the NIMBUS High Resolution Infrared Radiometer between 3.4 and 4.2 micron, where the gases  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ,  $\text{H}_2\text{O}$  contribute to atmospheric absorption and emission.

## 2. FUTURE WORK

- a. TIROS IV radiation data measured during a period of about 20 weeks shall be presented in weekly averages on quasiglobal maps. From these averages the relative humidity of the troposphere and the surface temperature shall be determined subsequently.

Furthermore, investigations will be undertaken to take into account the true atmospheric temperature distribution in determining the water vapor mass above 500 m

from the values of the mean relative humidity of the upper troposphere. The main part of that work will be done by Dr. Raschke during his visit of the Goddard Space Flight Center.

- b. On the basis of the method developed in the previous grant, the influence of minor atmospheric constituents on the outgoing radiation which is received by the Nimbus HRIR - instrument will be calculated, and possible consequences on the determination of the temperature of cloud-tops or surfaces will be examined.
- c. Another method will be developed for calculations of the outgoing radiation with a spectral resolution of  $5 \text{ cm}^{-1}$ , which also shall be used in spectral regions where several atmospheric gases influence the amount of the outgoing radiation. We will try to compare calculations based on this method with real atmospheric spectra which were recorded by balloon measurements. Such spectra generously have been made available to us by Dr. W. Nordberg, Goddard Space Flight Center and Mr. Bartman, Ann Arbor.

It will be studied, how some of the parameters of the calculations must be modified to get the best coincidence between calculations and measurements.

### 3. PERSONNEL AND ADMINISTRATIONS

Project Director :	Prof. Dr. F. Möller
Research Associates :	Dr. E. Raschke
	Dipl.-Phys. I. Tannhäuser
Technical Associates:	F. Lehner
Student Associates :	F. Kracher, R. Kreis,
	F. Metzger, J. Osterlag,
	R. Renasco, M. Renasco,
	M. Schöner, G. Höl.

5. TRAVELS

I. Tannhäuser was from the 18<sup>th</sup> of May to the 10<sup>th</sup> of June with the Meteorology and Aeronomy Division at NASA Goddard Space Flight Center in Greenbelt. There she prepared the evaluation of TIROS IV radiation data.

At the 11<sup>th</sup> of June she visited the Laboratory of Molecular Spectroscopy of the Ohio State University to discuss with Prof. John H. Shaw measurements of absorption functions of atmospheric gases which are needed for the interpretation of atmospheric radiation measurements. At Ohio State University she also attended the 19<sup>th</sup> Symposium on Molecular Spectroscopy (13<sup>th</sup> June - 18<sup>th</sup> June).

Furtherto I. Tannhäuser visited Dr. Bartman and his team at the Institute of Science and Technology of the University of Michigan to discuss tests of radiation measurements at balloon flights (21<sup>st</sup> of June).

At the Goddard Institute for Space Studies in New York finally (22<sup>nd</sup> of June) I. Tannhäuser discussed problems of radiative transfer with Drs. Rasool, Arking and other scientists of the Institute.

Munich, September 21, 1965

F. Möller  
(Prof. Dr. F. Möller)